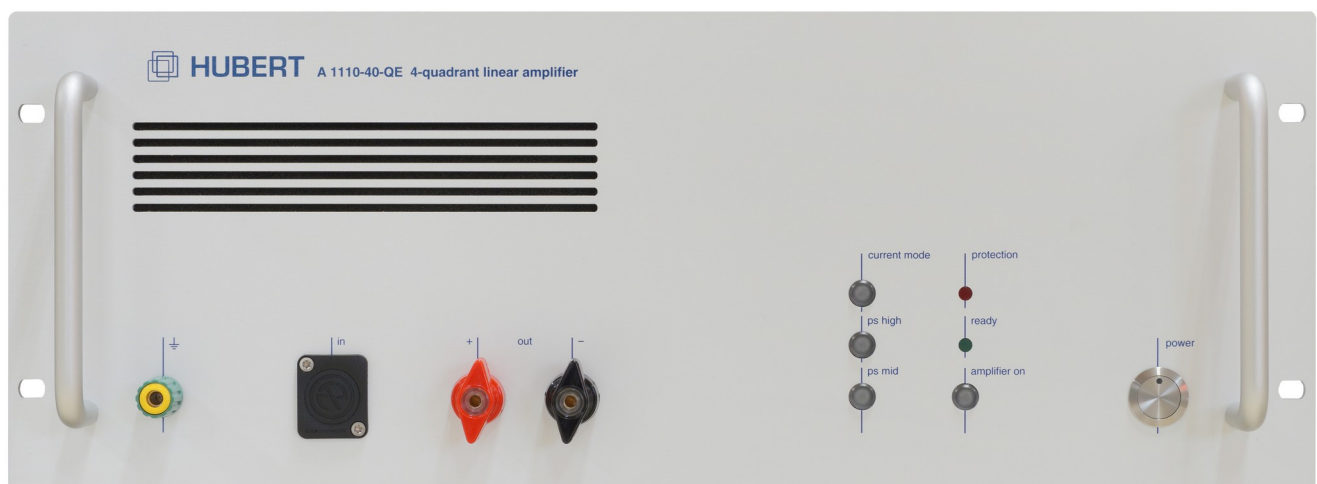




# HUBERT

amp up your process

## Operating Manual



# A1110-40-QE

# A1110-40-QE-100

**4-Quadrant Voltage and Current Amplifier**  
**DC - 1 MHz**

# Contents

- 1 Introduction.....3
- 2 For Your Safety.....4
- 3 Important Information for Initial Operation.....8
- 4 Operating Elements.....11
- 5 A1110-QE Control Software.....15
- 6 Notes on Operation.....21
- 7 Applications.....27
- 8 Integration into Automated Test Systems.....28
- 9 Maintenance and Service.....33
- 10 Decommissioning and Disposal.....34
- 11 Warranty.....34
- 12 Contact Information.....35
- 13 EU Guidelines.....35
- 14 Document History.....36



# 1 Introduction

## 1.1 Device Description

The A1110-40-QE is a linear, extreme-broadband, precision power amplifier designed for all applications which require fast-changing signals with high performance.

The A1110-40-QE can be operated as a voltage amplifier or current amplifier. The current amplifier offers a constant, frequency-invariant output current for inductive loads.

Three optional operating voltages per polarity are available for high-voltage/low-current or low-voltage/high-current applications. The voltage switch-over can be implemented optionally as manual or automatic. Especially in case of very low-impedance loads, the operating voltage can be reduced to 1/10 which is associated with a corresponding reduction of the power loss.

Output voltage and output current can be limited and observed on low-impedance monitor outputs.

The device is equipped with a temperature-controlled, quietly-running fan. As well as an over-temperature protection, a power-loss calculation and an absolute-current monitoring guarantees perfect short-circuit and overload protection.

An interlock offers the possibility of a remote-controlled security system.

The device can be operated by using elements on the front panel. Additionally the device can be controlled with the supplied A1110 Control Software via an USB connection.



### NOTICE



#### **Always read the enclosed data sheet**

The separate data sheet is part of these operating instructions and must also be read and understood. Device-specific modifications on customer request can only be found in the data sheet! The data sheet is part of the scope of delivery of the device and can be downloaded from our website [www.drhubert.com](http://www.drhubert.com).

## 1.2 Scope of Delivery



- USB thumb-drive including
  - These operating instructions
  - Application software
  - Datasheet
- Power cable
- USB cable
- Adapter BNC/XLR







## 2 For Your Safety



### 2.1 Used Symbols and Notations

#### 2.1.1 Warning Level

	<b>DANGER</b>	
<b>Type and source of danger</b>		
Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.		

	<b>WARNING</b>	
<b>Type and source of danger</b>		
Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.		

	<b>CAUTION</b>	
<b>Type and source of danger</b>		
Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury or property damage.		

	<b>NOTICE</b>	
<b>Type and source of danger</b>		
Indicates important information about the product or procedures that should be considered for the correct functioning of the device.		

#### 2.1.2 Used Warning Symbols



Warning about a dangerous voltage



Warning about general danger





Description of what should be done or what to pay attention to



## 2.2 General Safety Advice

The following general safety instructions must be observed during the use of this device. Disregarding this advice or specific warnings in this manual will violate safety standards in the intended uses of this equipment.

The manufacturer is not responsible for consequences resulting from disregarding the advice and warnings.

 **DANGER** 

**Electrical voltage – Danger of electric shock**

**Parts under voltage:**

Always cover all parts under voltage that inevitably arise during operation.

**Touching of cables, sockets and plugs:**

Never touch the contacts of cables, sockets or plugs directly after disconnecting them, as there is a risk of electric shock.

**Contact between amplifier outputs and PE:**

Touching an amplifier output and PE at the same time can result in a life threatening electric shock.

**Earth the device:**

The device fulfills the requirements for protection class I. To avoid the risk of electric shock, the device housing must be earthed and therefore always operate the device via the supplied three-core power cable with protective conductor. The mains cable may only be plugged into a grounded socket with a protective earth contact. An interruption of the protective earth conductor inside or outside the device reduces the safety of the device and is prohibited.

**Safety Regulations for the work with electrical equipment:**

- Disconnect mains!
- Prevent reconnection!
- Test for absence of harmful voltages!
- Ground and short circuits!
- Cover or close of nearby live parts!



**Devices with a heavy current connection:**

Devices with a heavy current connection may only be operated via a 4-pole RCD with  $\leq 40$  ms at  $5 \times I_{\Delta n}$ . If it is not possible to install the RCD in the building installation, then our device must be connected to the mains supply via a mobile distributor with the appropriate RCD.

**Do not open the housing:**

Covers must not be removed by the operating personnel. Maintenance and repair work is reserved exclusively for qualified service personnel.



	CAUTION	
<b>Important notes</b>		
The device must be used exclusively for its intended purpose.		
The device is only approved for operation within the connected loads specified on the type label.		
Do not insert any mechanical parts, especially metal parts, into the device through the ventilation slots.		
Protect the unit from moisture, humidity and condensation. Avoid using liquids near the device.		
Never connect loads while the amplifier outputs are switched on.		
Operate the device exclusively on the public power supply system (no generators/UPS).		

To avoid personal injury and property damage, make sure that the equipment and components used in the test are not overloaded. Read all operating instructions for the devices used thoroughly and ensure that all defined device limits are adhered to. If there are doubts about the suitability of the devices for the test to be performed, contact the manufacturer of the device.

## 2.3 Intended Use



### 2.3.1 Hardware

The device is intended exclusively for use as an LF power amplifier. Typical applications are the operation as voltage and current amplifier on low impedance passive loads. Active loads are only permitted under certain conditions in agreement with the manufacturer.

	CAUTION	
<b>Operation on active loads</b>		
Active loads are only permitted under certain conditions in agreement with the manufacturer.		

The device may only be operated within the technical data and under the ambient conditions specified in this manual.

Changes to the device are not permitted without the consent and release of the manufacturer. Proper and safe operation of the device requires correct installation and careful operation. This manual is part of the device and must always be accessible to the user. Observe all safety regulations listed in this manual.

	CAUTION	
<b>The improper use leads to the exclusion of any liability claims.</b>		
The operator alone is liable for all damage caused by improper use.		





### 2.3.2 Software



'A1110 Control' and 'A1500 Control' are software developed to control and configure HUBERT power amplifier. Take into account technical data and applications described in this manual. Changes to the software are not permitted without the consent and release of the manufacturer. Proper and safe operation of the software requires correct installation and careful operation. This manual is part of the software and must always be accessible to the user. Observe all safety regulations listed in this manual.

## 2.4 User

Operation may only be performed by qualified persons.

	CAUTION	
<p><b>Reading and understanding the operating instructions</b></p> <p>Never use the device without having read and understood the operating instructions. Always contact the manufacturer if you have any questions.</p>		

Qualified persons within the meaning of the safety instructions in this manual are authorized persons for commissioning and operating systems in accordance with the standards of safety technology.

	DANGER	
<p><b>Risk of injury in case of insufficient qualification</b></p> <p>Improper work can lead to personal injury and damage to property. Any work may only be carried out by persons who have the necessary training, knowledge and experience.</p>		





## 3 Important Information for Initial Operation

### 3.1 Introduction



It is imperative that the following operating instructions for the 4-quadrant power amplifier and the connected peripherals are read before installation and commissioning. Further information can be found in „White Paper No. 1“ on our website [www.drhubert.com](http://www.drhubert.com).



It is also imperative that the following operating instructions for the 4-quadrant power amplifier and the connected peripherals are read before installation and initial startup. Furthermore, the configuration and initial startup of the amplifier with the connected load must be carried out by appropriately trained and qualified personnel.

	CAUTION	
<b>Monitoring of output current and output voltage</b>		
The monitor outputs of the fast 4-quadrant power amplifier should always be used to monitor the voltage and current at the DUT in order to detect unwanted RF oscillations or other instabilities (extensive overshoots) at an early stage.		

### 3.2 Connecting the Power Outputs



Do not connect the 4-quadrant power amplifier output to any other amplifier, external power supply, signal source or other active, inappropriate loads. These special electrical components are not excluded as a load in principle but it requires a suitable security concept.

	NOTICE	
<b>Application Support</b>		
In the implementation of your application, our technical support is happy to help!		

	CAUTION	
<b>Overvoltage at the Power Output</b>		
The amplifier has no protection against overvoltage at the power output!		

Example: In the case of an inductive load, switching off the amplifier can lead to high voltages at the outputs and possibly to the destruction of the 4-quadrant power amplifier.

Take the appropriate safety measures (see option "Overvoltage Protection").

	CAUTION	
<b>Do not connect the outputs to the signal ground or the protective earth!</b>		
Multiple earthing can lead to unstable operation or interfere with current monitoring.		





### 3.3 Parallel Operation (Voltage Amplifier)

By connecting several 4-quadrant power amplifiers in parallel, the output current can be increased.

For safe operation it is absolutely necessary to

- only use identical amplifier models
- observe the wiring instructions and cable specifications for stable signal processing (e.g. equal cable length)
- ensure adequate mains supply
- ensure contact protection at the power outputs, life-threatening voltages can occur

For the operating mode "current amplifier" please contact our technical support.

	<b>CAUTION</b>	
<b>Parallel operation with an external active load or source is not permitted!</b>		

### 3.4 Series Operation (Voltage Amplifier)

By connecting several 4-quadrant power amplifiers in series, the output voltage can be increased.

For safe operation it is absolutely necessary to

- only use identical amplifier models
- observe the wiring instructions and cable specifications for stable signal processing
- ensure adequate mains supply
- ensure contact protection at the power outputs, life-threatening voltages can occur

For the operating mode "current amplifier" please contact our technical support.

	<b>CAUTION</b>	
<b>Series operation with an external active load or source is not permitted!</b>		

For the operating mode "current amplifier" please contact our technical support.

### 3.5 Series operation of DC- and 4-Quadrant Power Amplifier

In a series connection of a DC source and a 4-quadrant power amplifier, systems with different transmission characteristics (e.g. slew rate) and operating voltages are often used. Communication between the systems is also not always guaranteed.

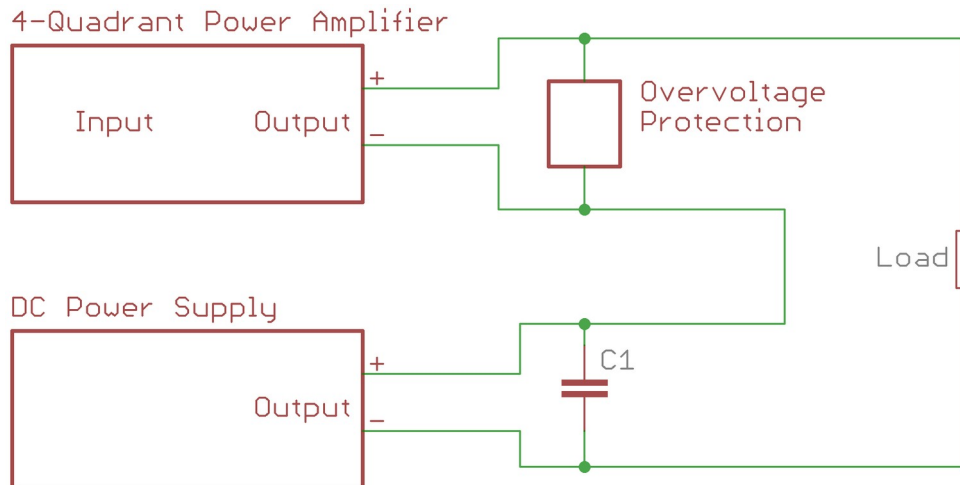




Figure 3.1: DC- and AC-Source (4-Quadrant Power Amplifier) in Series Operation

In the event of an error (for example the over-current protection of the power amplifier triggers, i.e. the output becomes high-impedance), this can lead to voltages at the amplifier output that are (permanently) above its supply voltage. Permanently if the DC source does not turn off.

	<b>CAUTION</b>	
<b>Overvoltage at the Power Output</b>		
The amplifier has no protection against overvoltage at the power output!		

	<b>NOTICE</b>	
<b>Overvoltage Protection</b>		
The device option "Overvoltage Protection" offers convenient overvoltage protection.		

## 4 Operating Elements

### 4.1 Front Panel Elements

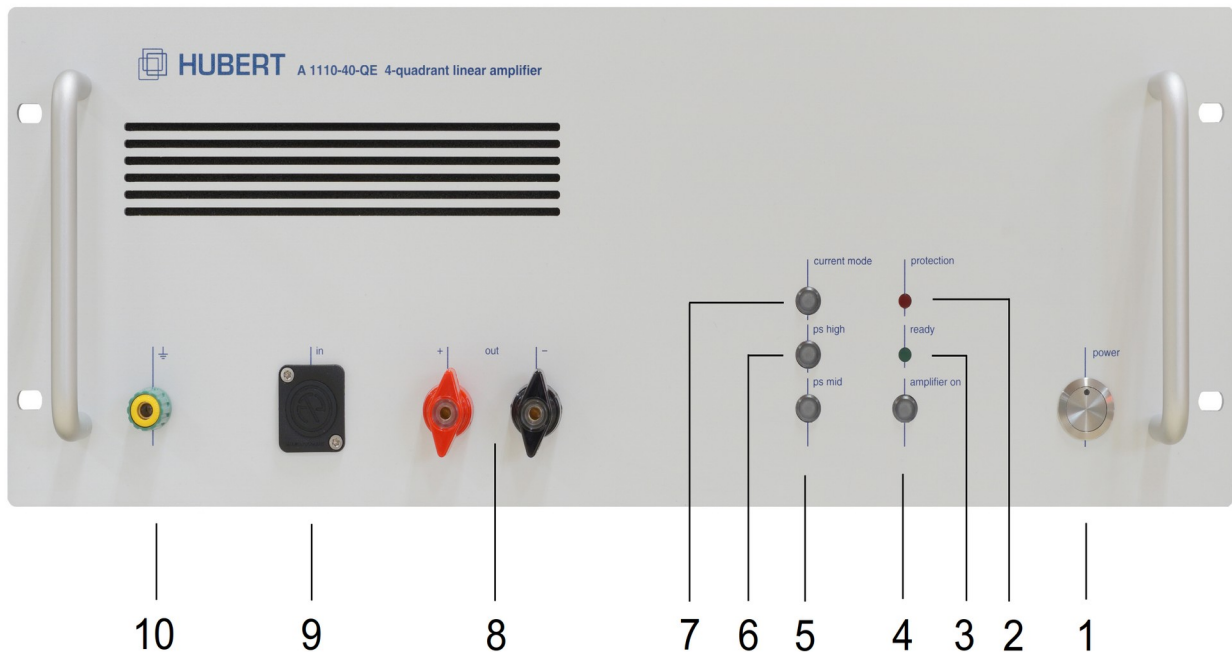


Figure 4.1: Front panel elements of A1110-40-QE

#### [1] POWER BUTTON

On / Off switch.

(Here is implemented the switchover ready to operate / standby. The standby mode is signaled by the weakly-lit, blue LED. The power supply disconnection is implemented with the switch on the rear side.)

⚠	<b>CAUTION</b>	⚠
<b>Do not switch under load!</b>		

#### [2] PROTECTION LED

Signals the intervention of a protection mechanism.

**Red LED lights up constantly:** Over-temperature disconnection; the device switches on automatically after the drop of the temperature.

**Red LED flashes slowly ( $\approx 1/s$ ):** Disconnection because of exceeding the permissible power loss.

**Red LED flashes rapidly ( $\approx 3/s$ ):** Hardware defective! The device must be sent to the manufacturer.



[3] **READY LED**

Green LED lights up when the amplifier is ready for operation.

[4] **AMPLIFIER ON BUTTON**

Green LED lights up, the amplifier is switched on.

[5] **PS MID BUTTON**

Operating voltage switch

Yellow LED lights up at medium operating voltage

[6] **PS HIGH BUTTON**

Operating voltage switch

Yellow LED lights up at high operating voltage

If both LEDs, PS MID and PS HIGH, are off, the automatic operating voltage switch is activated.

[7] **CURRENT MODE BUTTON**

Switching the operating mode. Please observe the notes in chapter "Operating mode current control".

Yellow LED off: Amplifier is in voltage amplifier mode.

Yellow LED lights up: Amplifier is in current amplifier mode.



**NOTICE**



**The current mode of this device is locked ex works!**

If it is necessary for you to enable it, please contact us here at HUBERT first, so we can give you specific advice related to your planned project.

[8] **OUT+ / OUT-**

Binding posts with flat clamp, amplifier output

Off-ground structure, reference potential (minus socket) is not connected with protective ground conductor.



**CAUTION**



**Do not connect outputs with signal ground or protective ground conductor!**

[9] **IN**

Symmetrical signal input; Insulated XLR socket

Pin1 = GND

Pin2 = +Signal

Pin3 = -Signal

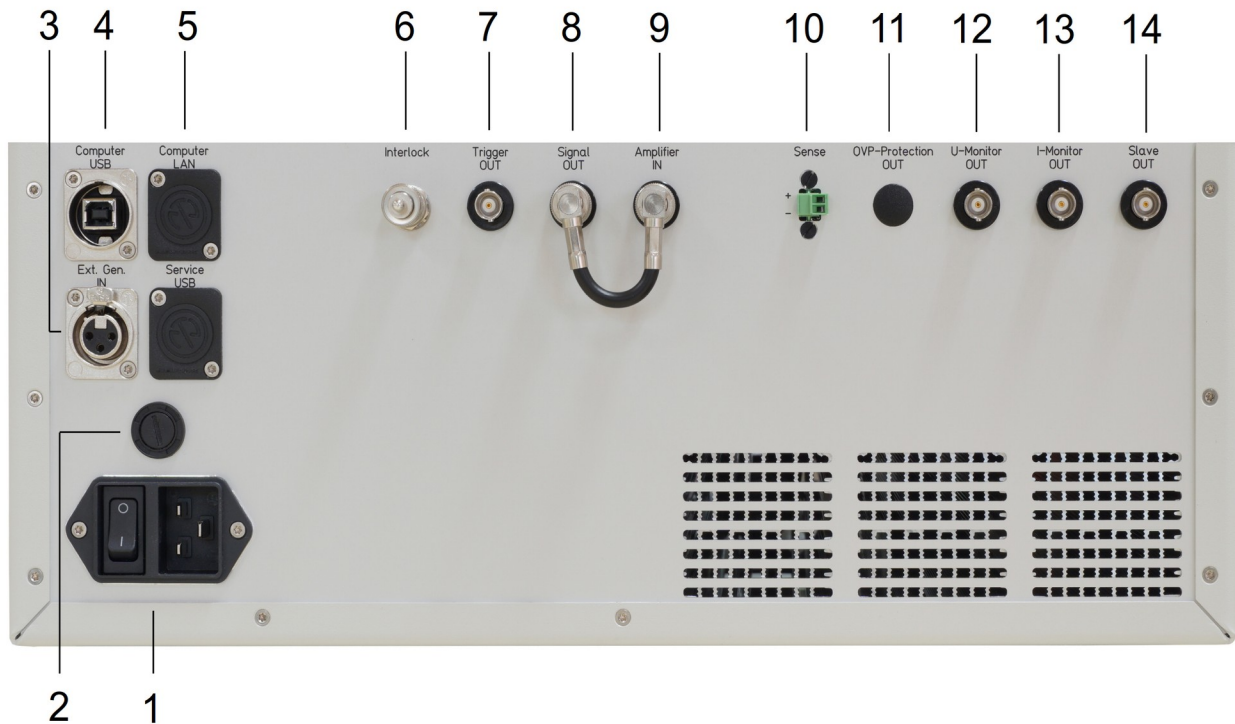
The enclosed BNC-XLR adapter serves for the connection of asymmetric sources or Pin1 and Pin3 must be connected.



## [10] GROUND SOCKET

Internal connection with the protective ground conductor.

## 4.2 Back Panel Elements



## [1] PLUG FOR NON-HEATING APPARATUS WITH MAINS SWITCH

Power supply

## [2] FUSE HOLDER

For fuses 32x6.3 mm

## [3] EXT. GEN. IN (OPTIONAL)

Connection of an external generator

## [4] COMPUTER USB

USB B-socket for connection to a computer

## [5] COMPUTER LAN (OPTIONAL)

RJ45-socket for connection to a computer network

## [6] INTERLOCK

BNC-socket with shorting plug.

A remote-controlled safety system enables the disconnection of the amplifier by an external switch (break contact).

LED status when protection was triggered: *Amplifier On*=off and *Ready*=on



**[7] TRIGGER OUT (OPTIONAL)**

TTL/CMOS-compatible output, synchronous signal to generator output

**[8] SIGNAL OUT (OPTIONAL)**

Optional generator output

**[9] AMPLIFIER IN (OPTIONAL)**

Optional amplifier input

**[10] SENSING**

The DC voltage drop on the load line can be adjusted between 0.5 V and 2 V.

Observe polarity!

**[11] OVP-PROTECTION OUT (OPTIONAL)**

Galvanically insulated switching output

**[12] U-MONITOR OUT**

Insulated BNC socket. Signal output for the monitoring of the amplifier output voltage.

**[13] I-MONITOR OUT**

Insulated BNC socket. Signal output for monitoring the amplifier output current. If the device has the additional option 02: Internal current measurement by high-power current transformer, the output signal of the current transformer is applied here.

**[14] SLAVE OUT**

Insulated BNC socket. Signal output for the activation of a further amplifier.



## 5 A1110-QE Control Software

### 5.1 Hardware and Software Requirements

To run the software, you need a computer running Windows 7 or Windows 10 and a free USB port.

### 5.2 Installation of the A1110-QE Control Software

Insert the supplied USB stick into an USB port on your computer. Open the drive in Windows Explorer and locate to setup.exe.

- Additional drivers and required additional programs are installed within the framework of the installation routine and require administrative access rights.
- The driver devices required for the device are tested and do not represent any security risk! The possible security risks documented by your operating system due to non-certified drivers can be ignored.
- Continue to follow the instructions on the screen.
- The installation program generates the directory A1110-QE-Control.



## 5.3 Operation of the Software

### 5.3.1 A1110-QE-Control

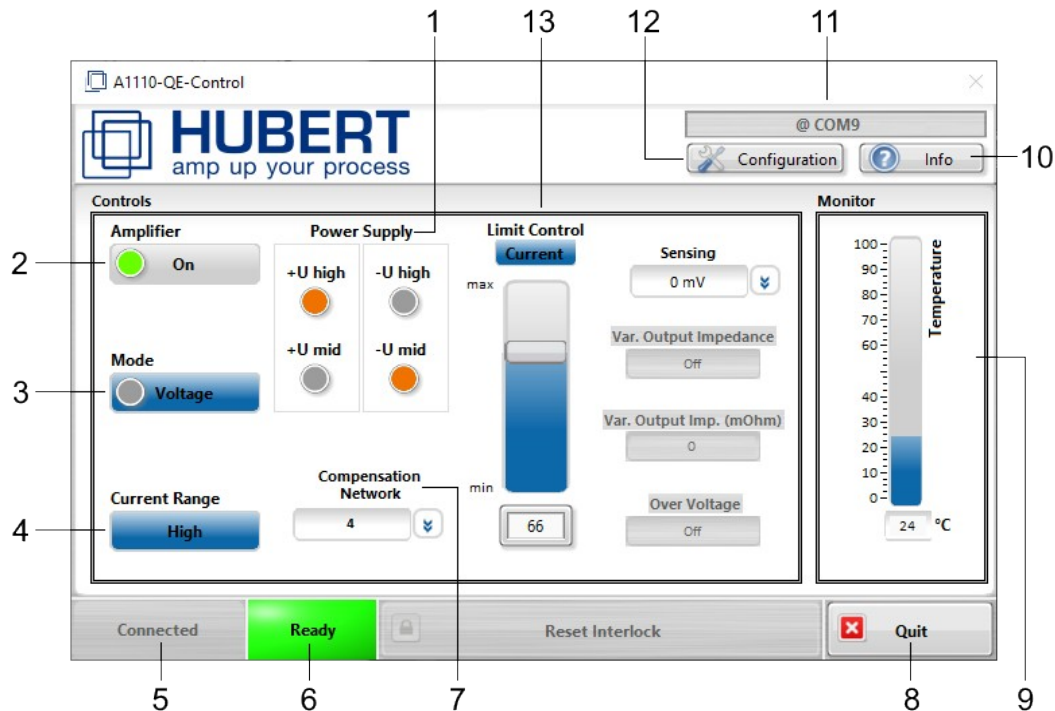


Figure 5.1: A1110-QE-Control Overview

The above control menu (A1110-QE-Control) includes the following buttons and indications:

#### [1] POWER SUPPLY

Selection of the operating voltage of the amplifier. Condition: Amplifier [2] must be switched off.

#### [2] AMPLIFIER

Switch amplifier on and off. The amplifier must be ready for operation.

Off: Amplifier is switched off, indication is off

On: Amplifier is switched on, indication is on

#### [3] MODE

Selection of the amplifier operating mode

Voltage: Voltage amplifier operating mode, indication off

Current: Current amplifier operating mode, indication on

#### [4] CURRENT RANGE

The type of the output-current measurement can be changed to increase the precision for low and high currents.





Current range = high for currents  $\geq 1$  A

Current range = low for currents  $< 1$  A, an overcurrent protection is activated with currents  $> 1$  A.

## [5] CONNECT

Selection and activation of the device interface. (USB).

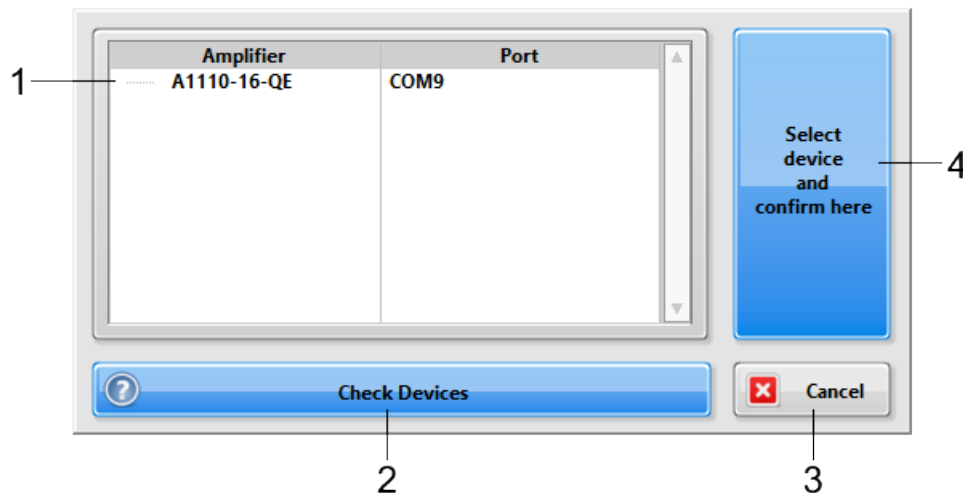


Figure 5.2: Device Indication

(1) The available amplifiers are listed with the corresponding port. The device name can be freely selected by double-clicking on a list entry (please note the tooltip).

(2) With the help of Check Devices you can search again for connected devices.

(3) Exit the menu by clicking on "Cancel".

(4) A connection is established after device selection and confirmation via "Select device and confirm here".

## [6] STATUS

### Green, Ready:

Signals the operational readiness of the amplifier.

### Red, Overcurrent:

The maximum admissible current of the amplifier or working range of the power semiconductors was exceeded.

### Red, Overload:

The maximum permissible power loss of the amplifier was exceeded.

### Red, Overtemp:

The maximum permissible temperature of the power semiconductors was exceeded

### Red, Transformer:

The maximum permissible temperature of the power supply has been exceeded.

### Red, Interlock:

A safety shutdown was triggered via the interlock.



### **Reset Interlock:**

Only possible if interlock mode latching is configured. The interlock function must be reset manually after the safety shutdown has been completed. The amplifier can now be switched on again (Amplifier On).

## **[7] COMPENSATION NETWORK**

Selection of a compensation network for inductive loads. Possible only if the current amplifier mode is activated.

## **[8] QUIT**

Ends the application.

## **[9] TEMPERATURE**

The temperature of the power semiconductors is displayed in °C. At 85 °C the amplifier is switched off. If the temperature drops below 40 °C, the amplifier is automatically switched on again.

## **[10] INFO**

Here you will find information about your GUI software version, the amplifier firmware and the amplifier hardware.

## **[11] DEVICE INDICATION**

The selected amplifier's name is displayed.

## **[12] CONFIGURATION**

The configuration menu is called up (see next section).

The following properties of the A1110-QE can be preset using the configuration menu (Startup Configuration). The amplifier then starts with the set options after it has been repeatedly switched on.

## **[13] LIMIT CONTROL**

The output current or the output voltage can optionally be limited.

Since the control is not arbitrarily fast (100 us), this device is suitable for limiting DC signals or slow AC signals to protect connected loads against overload. In the current amplifier operating mode, instabilities can occur with inductive loads with intentional overcompensation (step response shows overshoot).



### 5.3.2 Startup Configuration

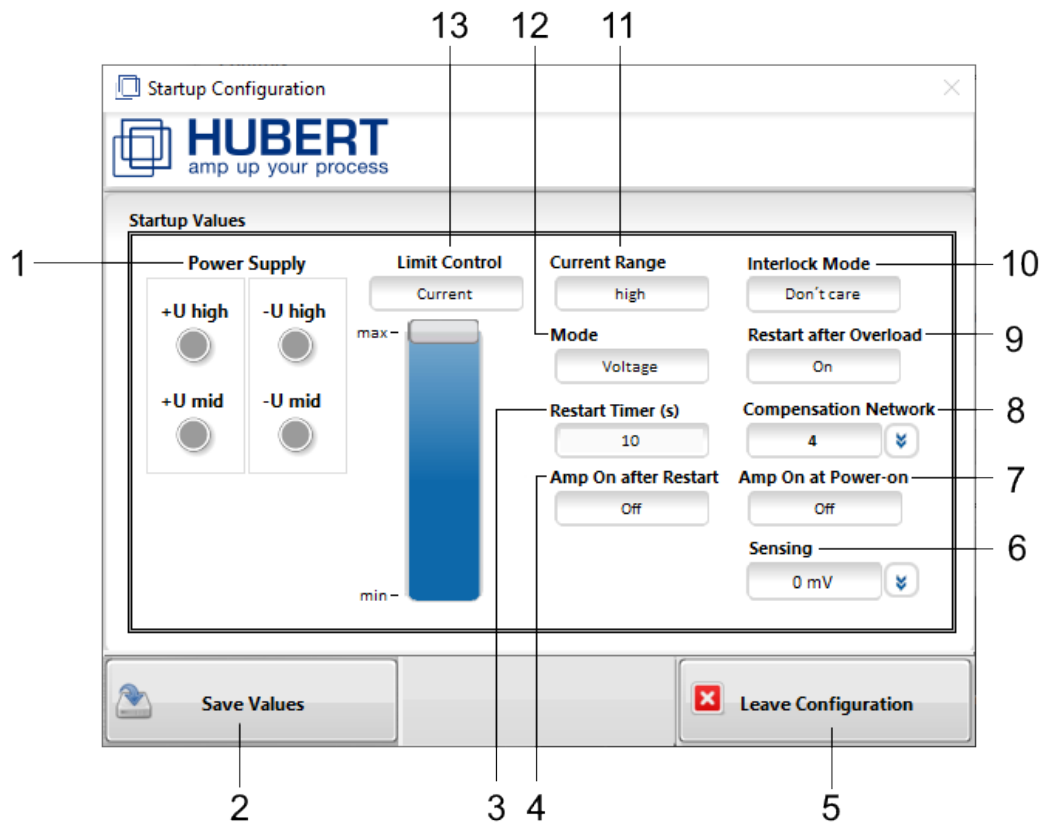


Figure 5.3: Startup configuration values

**[1] POWER SUPPLY**

Selection of the operating voltage of the amplifier.

**[2] SAVE VALUES**

The configuration values are stored as initial values in the amplifier.

**[3] RESTART TIMER**

The timing for the restart can be selected between 10 s and 254 s.

**[4] AMP ON AFTER RESTART**

After the restart, the amplifier is switched on.

**[5] AMP ON AT POWER ON**

After switching on the device (power), the amplifier is switched on also.

**[6] LEAVE CONFIGURATION**

Exit the configuration menu and return to the control menu.

**[7] SENSING**

The DC voltage drop on the load line can be adjusted between 0.5 V and 2 V.



0 mV: Sensing is deactivated

**[8] COMPENSATION NETWORK**

Selection of the required compensation network.

**[9] RESTART AFTER OVERLOAD**

After a safety shutdown is triggered, the amplifier switches on again after 10 seconds or more.

**[10] INTERLOCK MODE**

Latching: Safety shutdown circuit must be reset manually.

Live: Safety shutdown circuit resets automatically.

Don't care: safety shutdown will be ignored.

**[11] CURRENT RANGE**

Selection of the current measuring range (only "high" available).

**[12] MODE**

Selection of the amplifier operating mode.

**[13] LIMIT CONTROL**

Presetting and selection of the max. output variable.




## 6 Notes on Operation

### 6.1 General Information

Make sure there is enough space behind and in front of the amplifier to allow air to circulate freely through the unit. Cool air is sucked in through the slots on the left and right sides of the front panel. Do not connect the amplifier to the power outlet until input and output are wired. Allow the amplifier to warm up for 15 minutes after power-up to stabilize its operating points.

### 6.2 Operating Voltages (A1110-40-QE and A1110-40-QE-100)

**CAUTION**

**Check your product model**

This chapter applies only to the models mentioned. Read the appropriate chapter for your product to prevent damage to the device.

Before you start "amplifying", we recommend that you consider the choice of operating voltage for effective and safe operation of the A1110-40-QE (see also White Paper No.1: Hubert Power Amplifier).

The operating voltage should always be selected according to the load:

- High operating voltage for high output voltages and low output currents
- Low operating voltage for low output voltages and high output currents

The A1110-40-QE has three operating voltages and the two operating modes Auto and Manual.

Mode	+ Operating Voltage	- Operating Voltage
Auto	10 V, 35 V, 90 V	-10 V, -35 V, -90 V
Manually: + Umid	35 V	auto
Manually: + Uhigh	90 V	auto
Manually: - Umid	auto	-35 V
Manually: - Uhigh	auto	-90 V
Manually: + Umid , -Umid	35 V	-35 V
Manually: + Umid , -Uhigh	35 V	-90 V
Manually: + Uhigh , -Umid	90 V	-35 V
Manually: + Uhigh , -Uhigh	90 V	-90 V

Table 6.1: Operating voltages A1110-40-QE (see also data sheet)



Mode	+ Operating Voltage	- Operating Voltage
Auto	10 V, 35 V, 110 V	-10 V, -35 V, -110 V
Manually: + Umid	35 V	auto
Manually: + Uhigh	110 V	auto
Manually: - Umid	auto	-35 V
Manually: - Uhigh	auto	-110 V
Manually: + Umid , -Umid	35 V	-35 V
Manually: + Umid , -Uhigh	35 V	-110 V
Manually: + Uhigh , -Umid	110 V	-35 V
Manually: + Uhigh , -Uhigh	110 V	-110 V

Table 6.2: Operating voltage A1110-40-QE-100 (see also data sheet)

In the operating mode “Auto”, the operating voltage is switched automatically depending on the signal amplitude. This mode is suitable for real-time applications with DC voltages and sinusoidal signals where high sink power is required at inductive loads. The rise time for pulse-like signals must not be less than 10  $\mu$ s.

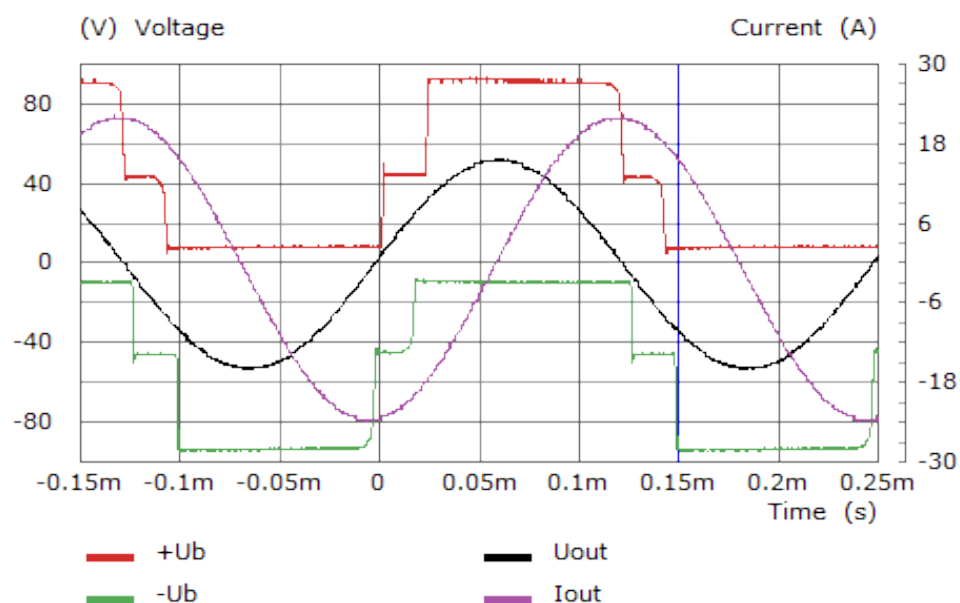


Figure 6.1: Output Voltage and Current @ Load=86  $\mu$ H

The figure above shows the 4 quadrant amplifier working on an air coil. At the time of the blue marker (0.15 ms) the output current is positive ( $I_{out}=15,5 A_p$ ) and the output voltage ( $U_{out}=-35 U_p$ ) negative. The amplifier operates as a sink in the second quadrant of the U-I diagram.

The negative operating voltage is correspondingly set to -90 V and the positive operating voltage is set to a minimum of +10 V. Thus the power dissipation in the amplifier is minimal.



For very fast pulse processing and high signal quality, the operating voltage can be switched manually. Unbalanced operating voltages are also possible and therefore the A1110-40-QE can also be used as an active load in this operating mode (see data sheet for maximum sink power).

The high operating voltage is suitable to achieve the desired output voltages, with high-impedance loads ( $>5 \Omega$ ). For example with  $10 \Omega$  at  $5 V_{dc}$  input voltage,  $50 V_{dc}$  output voltage are generated. Then a  $5 A_{dc}$  current is flowing through the load.

In order to let even larger currents flow at low impedance loads ( $<1 \Omega$ ), one uses the low operating voltage  $U_{mid}$ .

#### Example:

Load:  $R_L = 1 \Omega$

For  $I_L = 5 A_{dc}$  an output voltage  $U_a = 5 V_{dc}$  is required ( $U_a = I_L \cdot R_L$ ). The power loss at the power stage results from the voltage loss at the power stage dc.

Load 2:  $R_L = 1 \Omega$

For the same load current  $I_L = 5 A_{dc}$  an output voltage  $U_a = 5 V_{dc}$  is required. The power loss at high operating voltage is thus:

$$P_v = (U_B - U_a) \cdot I_L = (90 V - 5 V_{dc}) \cdot 5 A_{dc} = 425 W$$

If a change is now made to the operating voltage  $U_{mid}$ , the following display results:

$$P_v = (U_B - U_a) \cdot I_L = (35 V - 5 V_{dc}) \cdot 5 A_{dc} = 150 W$$

As you can see from this example, it makes more sense to operate the amplifier with a low operating voltage for low impedance loads and with a high operating voltage for high impedance loads.

An illustration with the maximum output voltages and output currents (U-I plot) can be found in the data sheet.

## 6.3 Connecting the Signal Source

The A1110-40-QE has a balanced input which offers advantages for long signal paths (see also White Paper No.4 Balanced Input). If your signal source does not offer a balanced output, you can use a BNC/XLR adapter (accessory supplied) to unbalance the signal. Always use high quality low capacitance ( $<60 \text{ pF/m}$ ) shielded cables for wiring.

## 6.4 Connecting the Load

The output of the A1110-40-QE has pole terminals with flat knobs. The integrated 4 mm safety socket is only suitable for currents  $< 32 A$ . When wiring your load, please also consider sufficient protection against accidental contact; life-threatening voltages can occur.

For safe and stable operation, the cables should be as short as possible and of the same length. The cable cross-section should not be less than  $4 \text{ mm}^2$ .



## 6.5 Initial Operation in Operating Mode Voltage Amplifier

Connect the mains cable and switch on the mains voltage at the mains switch. The illuminated **Power** button signals *standby* and you can switch on the device. After a short time, ready lights up and the amplifier is now **Ready** for operation.

Start the software and establish a data connection with the amplifier. Select the operating mode **Voltage Mode** and the required operating voltage according to your application. With **Amplifier On** you switch on the signal input and the power output and the signal processing can begin.

 **CAUTION** 

**Do not switch off the power supply under load!**

The **Voltage Monitor Out** and **Current Monitor Out** outputs can be used to control the corresponding signal shapes.





## 6.6 Initial Operation in Operating Mode Current Amplifier

In current control mode, the A1110-40-QE behaves like a voltage-controlled current source and delivers a nearly frequency-independent constant load current to an inductive load. The figure below shows examples of the transients of output voltage and current in the operating modes "current control" and "voltage control" on a coil.

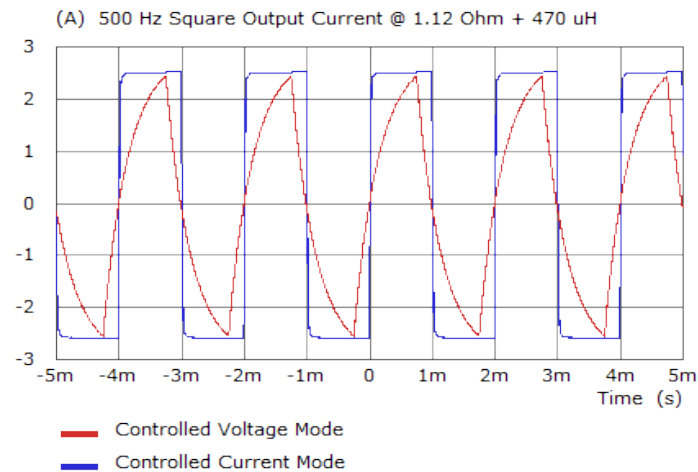


Figure 6.2: Voltage Mode vs. Current Mode



### NOTICE



**With this device the current mode is blocked ex works!**

If you need to activate it, please contact our support team and ask for specific advice regarding your project.

Since the load represents an integral part of the control in the "current control" mode, the amplifier must be compensated for stability reasons with an RC network adapted to the load.

The following instructions for safe operation of the A1110-40-QE must also be observed:

- 1 Never put the amplifier into operation without load.
- 2 A DC current path must always be existing through the load.  
Never employ capacitors in the signal path.
- 3 Wire up the amplifier completely before operational startup.
- 4 Pay attention to correct compensation.
- 5 Monitor the output current for stability.
- 6 Do not change the operating mode during operation.

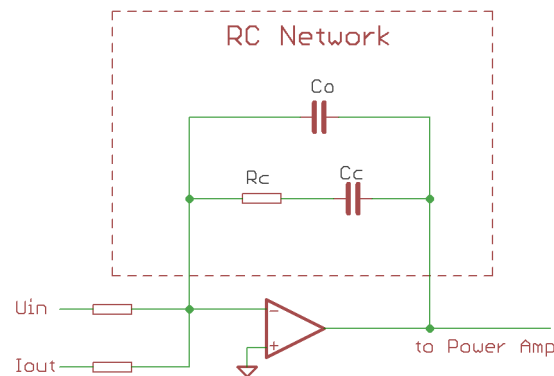


Figure 6.3: Simplified Current Controller

The figure above shows the RC network required for the current controller.

If no customer-specific solution was required, the following networks are equipped ex works:

No	Load	Rc	Cc	Current Range
1	1 Ohm + 500 uH	100 kOhm	10 nF	high
2	0,1 Ohm + 200 uH	68 kOhm	4,7 nF	high
3	1 Ohm + 1mH	150 kOhm	22 nF	high
4	4 Ohm + 1,8 mH	200 kOhm	1 nF	high
5	Reserved for Option-01			
6	Reserved for Option-01			

Table 6.3: Compensation networks

The selection is made by software. Please also note the corresponding recommended current measuring range.

Network No 7 allows the determination of a suitable compensation by means of a switchable capacitor bank and a variable resistor.

If you ordered your device with *Option-01 Custom Current Amplifier*, your custom network is installed in slot #5 or #6.

After you have wired the amplifier and connected it to the load, you can enable the mains voltage at the mains switch. The illuminated power button signals standby and you can switch on the unit. After a short time, the *Ready* LED is lit and the amplifier is now ready for operation.

Start the software for further settings and retrieving its status. Now establish a data connection to the amplifier. Select the required operating voltage and the required compensation network according to your application.

- Activate the **Current Mode**. This connects the amplifier output to the load. The control loop is closed.
- Switch on the signal input and the power output by selecting **Amplifier On**. The signal processing can begin.



At the outputs **Voltage Monitor Out** and **Current Monitor Out**, the corresponding signal forms can be checked.

Leaving the Current Mode follows in reverse order:

- Switch off the external signal source first
- Switch off the signal input with **Amplifier Off**
- *Disable the **Current** Mode. The load can now be removed from the amplifier output.*



## CAUTION



**Never remove the load from the amplifier output in Current Mode!**

## 7 Applications

Please find more information in sections „White Papers“ and „FAQs“ on our website

[www.drhubert.com](http://www.drhubert.com).



## 8 Integration into Automated Test Systems

For the integration of the A1110-40-QE into automated test systems, the instruction set is described in the following. A command frame is defined as follows:

<length of the frame> <command word> <opt. parameter>

The amplifier sends either the command or parameter as confirmation for a received and implemented command frame (see table below).

The adjustments of the characteristics in case of power loss disconnection and new start are stored in the device. In this case, the amplifier can be configured so that e.g. in case of power loss disconnection, it automatically switches on again after a configurable time of (10-254 s).

The commands described in this section are ASCII/Hex values which are transmitted as a hex value using a terminal program (e.g. HTerm, 9600 Baud, 8 Bit, one stop bit, no parity). These do not correspond to the SCPI standard and are defined as pure byte protocol.

!
**NOTICE**
!

**The connection to the device is established via USB interface.**

For a connection via LAN (Ethernet) the LAN option must be present in the device.

### 8.1 Remote Commands

Command frame (Tx)	Confirmation (Rx)	Remark and parameter description
<0x02><0x04>	<1 Byte>	Sending of the temperature in °C
<0x02><0x10>	<1 Byte>	Send device status: Bit 0 : Ready Bit 1 : Overload Bit 2 : Overtemperature Bit 3 : Don't care Bit 5/6: Don't care Bit 7: Device on/off
<0x03><0x20> <Parameter>	<1 Byte>	Setting of the switch-on state:  Bit 0 : operational readiness after overload (0: off; 1:on) Bit 1 : device on/„Amp-On“ when switching on (0: off; 1:on) Bit 2 : device on/„Amp-On“ after being switched on again after Overload (0: off; 1:on)
<0x03><0x21> <Parameter>	<1 Byte>	Setting of the switch-on delay time after an overload disconnection in seconds (0x0A until 0xFE).
<0x02><0x22>	<1 Byte>	Sending of the switch-on state: Bit 0 : operational readiness after overload (0: off; 1:on) Bit 1 : device on/„Amp-On“ when switching on (0: off; 1:on) Bit 2 : device on/„Amp-On“ after switching on again after overload (0: off; 1:on)
<0x02><0x23>	<1 Byte>	Setting of the switch-on delay time after an overload disconnection in seconds
<0x02><0x24>	<1 Byte>	Sending of amplifier-type: 0x03 : 5A Type 0x04 : 16A Type 0x05 : 40A Type
<0x02><0x25>	<2 Bytes>	Sending of firmware version (component 1)



Command frame (Tx)	Confirmation (Rx)	Remark and parameter description
		1. Byte : Main-Revision 2. Byte : Sub-Revision
<0x03><0x28> <Parameter>	<0x28>	Setting of the current measuring range: 0x00 : High 0x01 : Low
<0x03><0x29> <Parameter>	<0x29>	Setting of the required RC network: 0x01 bis 0x07
<0x03><0x2A> <Parameter>	<0x2A>	Setting of the amplifier operating mode: 0x00 : Voltage Mode 0x01 : Current Mode
<0x03><0x2B> <0x00>	<0x2B>	Resetting of the Interlocks in Latching-Mode
<0x04><0x2D> <1. Parameter> <2. Parameter>	<2 Bytes>	Setting of the Limit Control: 1. Parameter : Highbyte (0x00 bis 0x0F) 2. Parameter : Lowbyte (0x00 bis 0xFF)
<0x0A><0x2E> <1. Parameter> <2. Parameter> <3. Parameter> <4. Parameter> <5. Parameter> <6. Parameter> <7. Parameter> <8. Parameter>	<0x2E>	Setting of the extended switch-on configuration of the amplifier:  1. Parameter : Current measurement range 0x00: High 0x01: Low 2. Parameter : RC-Network 0x01 until 0x07 3. Parameter : Amplifier operating mode 0x00 : Voltage Mode 0x01 : Current Mode 4. Parameter : 0x00 : No other value is permissible! 5. Parameter : Highbyte of the limit control (0x00 bis 0x0F) 6. Parameter : Lowbyte of the limit control (0x00 bis 0xFF) 7. Parameter : Interlock Mode 0x00 : latching 0x01 : live 0x02 : don't care 8. Parameter: Limit Control 0x00 : Current 0x01 : Voltage 9. Parameter: Operating Voltage (see command 0x54)
<0x02><0x2F>	<8 Bytes>	Sending of the extended switch-on configuration of the amplifier (see above)
<0x03><0x35> <Parameter>	<1 Byte>	On/Off switching of the amplifier: 0x00 : off 0x01 : on
<0x02><0x38>	<12 Bytes>	Query the operating parameters. 1. Parameter: Current measurement range (see 0x28) 2. Parameter: RC-network (see 0x29) 3. Parameter: Amplifier operating mode (see 0x2E) 4. Parameter: Don't care 5. u. 6. Parameter: Limit Control Value 7. u. 8. Parameter: Limit Control Value 9. Parameter: Interlock Status (0: inactive; 1: active) 10. Parameter: chosen interlock-mode (0: Latching; 1: Live) 11. Parameter: Limit Control Modus (0: Current; 1: Voltage) 12. Parameter: chosen operating voltage (see 0x54)
<0x02><0x3A>	<2 Byte>	Query firmware revision



Command frame (Tx)	Confirmation (Rx)	Remark and parameter description		
<0x02><0x42>	<1 Byte>	Query the fault memory Bit 1: Transformer temperature exceeded Bit 2: Exceeded operating voltage limits Bit 3: Temperature exceeded Bit 4: Exceeded power loss limits Bit 5: Low Voltage Detection at the controller Bit 6: Exceeded current limits Bit 7: Hardware error		
<0x03><0x42> <0x01>	<1 Byte>	Query the second fault memory Bit 0: Overvoltage Protection Bit 1: Openloop Bit 2: Don't care Bit 3: Don't care Bit 4: Exceeded current limits (Impulse) Bit 5: Exceeded current limits (Safety Break) Bit 6: Don't care Bit 7: Don't care		
<0x02><0x51>	<128 Bytes>	Sending of the device ID (length changeable on customer request – firmware update required)		
<0x82><0x52> <128 ASCII Parameter>		Setting the device ID (blank 0x20) Standard: " <b>Device #1</b> "		
<0x03><0x53> <Parameter>	<0x53>	1. Parameter: setting of the limit controls (0x00: Current; 0x01 :Voltage)		
<0x03><0x54> <Parameter>	<0x54>	Parameter	Operating voltage	
			+	-
		1	Automatic	
		2	Mid	Automatic
		3	High	Automatic
		4	Automatic	Mid
		5	Mid	Mid
		6	High	Mid
		7	Automatic	High
		8	Mid	High
		9	High	High
<0x03><0x5D> <Parameter>	<0x5D>	Setting the Sensing Option (0: off; 1: 500 mV; 2: 1000 mV; 3: 2000 mV)		
<0x02><0x5E>	<1 Byte>	Sending the Sensing-Parameter (0: off; 1: 500 mV; 2: 1000 mV; 3: 2000 mV)		

Table 8.1: List of Remote Commands



## 8.2 Error Codes

Code	Description
0xFC	Illegal command. The option may not be available.
0xFD	Timeout. An incomplete command frame was received.
0xFE	Unknown command.

*Table 8.2: List of Error Codes*



## 8.3 TCP/IP Settings

To set and read the TCP / IP parameters, use the manufacturer's interface listed below!

Current devices: <https://www.lantronix.com/products/deviceinstaller/>

(Older devices: <https://www.eztcp.com/en/download/ezmanager.php>)

Drivers and product information on the currently used interfaces can be found at:

USB: <https://www.ftdichip.com/Drivers/D2XX.htm>

LAN: <https://www.lantronix.com/products/xpico/>





## 9 Maintenance and Service

### 9.1 Maintenance

The device works maintenance-free. Clean the device only with a damp cloth. Only use solvent-free cleaning agents without aggressive ingredients.

### 9.2 Service

If you have further questions about this product, please visit the support area on our website [www.drhubert.com](http://www.drhubert.com). If our support team informs you that your device must be returned, you will receive an RMA number.

To ensure fast processing, please note the following points:

- Shipment on a **pallet** is mandatory! Shipping without a pallet usually leads to considerable transport damage, the costs of which we do not cover.
- Please include the **RMA** number with the delivery (e.g. on the delivery note).
- Ensure that the packaging is safe for transport, the stresses during transport are **enormous**. If possible, use the **original packaging** when shipping the device.
- Repairs will only be carried out by Dr. Hubert GmbH. External interventions can be proven and will invalidate the warranty.

**Shipping Address:**

Dr. Hubert GmbH  
Service Department  
Dietrich-Benking-Straße 41  
44805 Bochum  
Germany

After we received your package the device will be diagnosed and we will provide you with a quote.



## 10 Decommissioning and Disposal

Decommissioning:

- Turn off the device.
- Unplug the power plug.
- Remove all cables.
- Store the device in its original packaging or equivalent.

Disposal:

Dispose of the device in accordance with local regulations for the disposal of electrical and electronic components.

## 11 Warranty

Dr. Hubert GmbH warrants this amplifier product for normal use and operation within specifications for a period of two (2) years from date of shipment and will repair or replace any defective product which was not damaged by negligence, misuse, improper installation, accident or unauthorized repair or modification by the buyer. This warranty is applicable only to defects due to material or workmanship. Dr. Hubert GmbH disclaim any other implied warranties of merchantability or fitness for a particular purpose. Dr. Hubert GmbH will not be liable for any indirect, special, incidental, or consequential damages (including damages for loss of profits, loss of business, loss of use or data, interruption of business and the like), even if Dr. Hubert GmbH has been advised of the possibility of such damages arising from any defect or error in this manual or product.



## 12 Contact Information

**Dr. Hubert GmbH**  
Dietrich-Benking-Str. 41  
44805 Bochum  
Germany  
  
Tel. +49 234 970569-0  
Fax. +49 234 970569-29  
[service@drhubert.com](mailto:service@drhubert.com)  
[www.drhubert.com](http://www.drhubert.com)

## 13 EU Guidelines

This device complies with the relevant European Union harmonisation legislation:

- EMC Directive
- Low Voltage Directive
- RoHS Directive



## 14 Document History

Revision	Date	Changelog
1.0	July 2019	First publication
2.0	March 2020	Extended safety warnings and advice
2.1	April 2020	German translations removed
2.2	December 2020	Model A1110-40-QE-100V renamed to A1110-40-QE-100
2.3	December 2020	Extended safety warnings and advice
2.4	January 2021	Model A1110-40-QE-70-16 removed Extended Remote Command
3.0	March 2021	First publication with new housing